

2 Barriers to barriers: why environmental precaution has delayed mobile floodgates to protect Venice

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Venice and the climate change debate

Venice has been implicated as one of the victims of global warming. The news media have sensationalised Venice 'sinking' as a result of rising sea levels. 'A global threat laps at the gates of Venice,' cried the headline to a climate change feature on the front page of the *International Herald Tribune*.¹

The Italian World Wildlife Fund (WWF) and conservationists Italia Nostra (Our Italy) promote the idea that Venice may soon be inundated because it will be subjected to rising sea levels from climate change. However, the Italian Green Party, working with these environmental groups, has also delayed Project MOSE, a system of 79 mobile barriers that would block the high tides that cause flooding.

They object that Project MOSE will damage the ecosystem of Venice and violate nature. WWF and Italia Nostra have jointly demanded the 'renaturalisation' of the lagoon.² Environmentalists have caused a false dilemma for Venice, for the question is not 'to preserve or not to preserve', but how Venetians can save their historical city from sinking and from flooding. This chapter will examine a specific case of how the precautionary principle informs environmental risk decisions in the context of climate change.

Venice's unnatural history

The formation of Venice was one of the most unnatural acts imaginable, instigated because a group of people sought to use its habitat to their advantage. Why would anyone try to build a city in a lagoon? As John Julius Norwich has eloquently described, its creators were the most intelligent people from the nearby mainland, who were fleeing barbarian invaders:

Thus it was that the wisest came to the islands of the lagoon. There, they believed, these savages from landlocked central Europe, lacking both ships and knowledge of the sea, would – with any luck – ignore them, turning their attention instead to the richer and far more tempting prizes on the mainland. They were right.³

Over time, they found that the lagoon's waters offered additional advantages, such as fish and salt. But constructing communities in a lagoon required extensive intervention in nature. Man-made land and dwellings were constructed in the lagoon's islands that offered settlements. Land needs were greater than nature provided and foundations were extended into the water.

In medieval times remarkable feats were achieved to pile the lagoon bottom with millions of alder tree supports on which a thick layer of Istrian Limestone slabs provided a flat and stable surface for building foundations. The top slabs were positioned at the water surface, thus protecting the structures from its impacts. Century on century created modern-day Venice with its 100 island units separated and connected by canals and bridges.⁴

Venetian society has constantly intervened in the lagoon for human development and to maintain the very existence of the lagoon. For instance, the Brenta and Sile Rivers that formerly flowed into the lagoon were diverted, as was the Po River to the south, a process that was completed in 1604.⁵ Other major projects to maintain the lagoon have included building defensive walls against the Adriatic Sea in 1744–83. These were considerable feats given that much of the work was done by hand.

Why is Venice 'sinking'?

The term 'sinking' confuses a number of phenomena that have caused flooding in Venice. Firstly, it is important to distinguish between the general rise in relative sea level (RSL) and the exceptional high tides, even though both contribute towards flooding. The exceptional high tides are the product of many factors, including rain, winds known as the *scirocco* and *bora* and storm surges. Storm surges in the Adriatic Sea do not appear to be related to global warming,⁶ even though their frequency is increasing.⁷ The astronomical causes of high tides can easily be predicted⁸ and storm surges can be forecast several days in advance.⁹ This is vital as the narrowness of the Adriatic makes its tides higher than in other parts of the Mediterranean Sea. Flooding has also been exacerbated by the deepening of the lagoon's channels and outlets to the sea for shipping, which has increased the speed of tide currents in the lagoon.¹⁰

Between 1897 and 1983, the RSL in Venice rose 23 cm, according to measurements by the Italian National Research Council; 12 cm of the 23 cm RSL rise was due to subsidence and 11 cm was caused by rising sea levels.¹¹ Current subsidence, or lowering of the land level, is mainly due to the self-weight of the city¹² and erosion of the lagoon's bed.¹³ Venice's sea levels have risen for many reasons, including the shifting of geological plates¹⁴ and climate change.

The principal reason for subsidence in Venice during the twentieth century was the extraction of groundwater from wells for the industrial complex at Marghera in the lagoon, especially between 1930 and 1970. Ghetti has explained how Venice's natural geological rate of 0.4 mm subsidence a year accelerated to 1.8 mm a year from 1930, and by 1950 it was 8 mm a year.¹⁵ It became worse between 1968 and 1969 when there was sinking of 17 mm at Marghera and 12 mm in Venice.¹⁶

Marghera's oil refinery was a serious mistake in terms of Venice's subsidence. But there was a positive response that stopped this abnormal subsidence: the Italian government ordered the closure of a large number of wells for Marghera's industrial zone and supplied it from surface watercourses after 1970. Greenpeace has run poison tours to parts of the lagoon they claim are 'toxic' and has continued to organise stunts at Marghera in its campaign against it. But industry and climate changes are not the only causes of flooding in Venice. As chronicles show, flooding has been plaguing the city for centuries¹⁷

and the rise in RSL has recently slowed. Now it is important to focus on the current and future causes of flooding.

There is a general consensus that subsidence can be predicted fairly accurately at 4 cm over the next 100 years,¹⁸ the planned lifespan of Project MOSE. The contemporary controversy is over the impact of climate change on the RSL for Venice.

Flooding in Venice

Venice is now flooded roughly 43 times a year, compared with seven times a year at the start of the twentieth century,¹⁹ causing damage to buildings and monuments. In 1996 the city was flooded on 100 occasions and in 1966 there were exceptional floods of almost 2 m above the sea-level tide meter at Punta della Salute.²⁰

By 1973, the Italian Parliament had passed Special Law 171 concerning Venice, and the idea of constructing mobile barriers to protect the city was legally recognised. The preliminary design of Project MOSE was completed in 1992. It was then approved by the Venice Water Authority Technical Committee (1992) and the Higher Council of Public Works (1994). However, it was not until 3 April 2003 that a system of mobile barriers was given definitive approval, with estimated completion in 2011.

The reasons for such a long delay in protecting Venice are varied and have changed over time. Some have blamed Italy's unstable political culture, the rigid bureaucracy and the system of political favours that have made continuity in public works difficult.²¹ There is also the cost of the mobile barriers, currently estimated at US\$3.5 billion. While political culture and costs have been influential, environmental concerns have become instrumental in delaying the mobile barriers since the mid-1990s.

Project MOSE

MOSE is an acronym for *Modulo Sperimentale Elettromeccanico* (Experimental Electromechanical Module). It is the system of 79 mobile barriers designed to protect the three entrances (at Malamocco, Lido and Chioggia) to the lagoon that surrounds Venice. The barriers would remain below the surface of the sea until high tides and flooding of the city are predicted, especially when storm surges are ex-

pected.²² Then Project MOSE's mobile gates will rise up to block high tides 110 cm above the Punta della Salute tide meter. A forecasting system will predict when the 110-cm flood limit will be exceeded, closing the gates at 55 cm six hours before 110 cm would be reached.²³

Project MOSE has been designed and is being constructed by Consorzio Venezia Nuova (New Venice Consortium) (CVN), a private pool of Italian building contractors established by the Italian state to oversee the design, construction and monitoring of work to safeguard the lagoon. CVN acts as a contractor for the Ministry of Infrastructure and Transport and the Venice Water Authority.

For Giancarlo Galan, President of the Veneto region, Project MOSE is 'historic'. As the construction began, Galan proclaimed 'the safeguarding of the city is finally starting to be carried out so there is hope for Venice.'²⁴

Additional and alternative anti-flooding proposals

Project MOSE's system of mobile barriers was chosen after considering many other mechanisms to separate the sea from the lagoon and after over a decade of testing. But its opponents, such as WWF and Italia Nostra, are still proposing alternatives that will have a minor environmental impact. The problem is that protecting Venice from flooding requires transforming the relationship of the city to the sea with significant impact.

The most popular alternative is simply to raise low-lying areas of Venice by 120 cm, much more than is currently planned. An International College of Experts, established in 1996 by the Italian government to evaluate Project MOSE, is sceptical of this alternative:

Such a measure would reduce the frequency of flooding under the present sea-level conditions down to about once a year. In practice, however, it would be difficult to implement, costly and time consuming. This alternative is as expensive as the mobile gates, would take 60 years or more to be completed, and would leave the city exposed for a long time to come. Since it would not protect against exceptional floods above 120 centimetres, it should be considered as only a partial solution.²⁵

Many non-governmental organisations (NGOs)²⁶ and opponents of MOSE have called for alternative forms of intervention that they believe are more beneficial for the lagoon's ecosystem:

These 'alternatives' include changing the geometric configuration of the breakwaters, filling the so-called '*Petroli*' (oil-tankers) channel, or reducing the depth of the sea bed at the lagoon openings. Although the utility of such measures is not entirely clear, their costs are prohibitive, and potential negative consequences are disastrous (to the point that they could in some cases be defined as *extravagant* measures).²⁷

The Report by the International College of Experts also stated that 'Such measures cannot be regarded as valid alternatives. However, some of them could be complementary to the mobile gates.'²⁸

It is often assumed that diffuse measures will benefit the lagoon's ecosystem. But the International College of Experts ascertained that diffuse measures would have both beneficial and negative environmental impacts.²⁹

CVN and other bodies have already improved the lagoon substantially in recent years utilising diffuse measures, including improving sea defences and water quality, and re-establishing the lagoon's morphology.³⁰ CVN helped to implement a programme that improved the ecosystem of the Palude della Rosa marsh in the northern lagoon.³¹ A report on bird habitats concluded 'Various measures planned and implemented by Consorzio Venezia Nuova along the coastline could have positive repercussions on the composition of the fauna present in these habitats.'³²

In addition, CVN and other organisations have begun to implement '*insulae*' (interior island infrastructure) defence measures. They have elevated paved surfaces outside and even inside buildings, and they have raised the height of seawalls surrounding the islands and along canal banks and directly lifted structures. These measures will protect the lagoon's towns, villages and Venice when tides rise up to 110 cm on the Punta della Salute tide meter. The gates from Project MOSE will protect Venice from tides above 110 cm.

These diffuse and *insulae* operations will complement Project MOSE, but will also have a minimal impact on reducing the flooding. In combination with the 'extravagant' measures called for by some

NGOs, it has been estimated that they 'would generally contribute to a reduction in the high water level in Venice of less than 6 cm (and the single and/or cumulative effect would be even smaller in the case of steep tidal flows)'.³³

The CVN company has based its work on environmentally friendly policies with 'environmental auditing-reporting based on eco-indicators' and the 'continuous re-orientation of engineering towards sustainability'.³⁴ For example, prefabricated systems were chosen to limit the impact on the local environment during construction of the gates, although some negative environmental consequences are inevitable during construction.³⁵ The operation of Venice's port has also integrated environmental precaution by involving NGOs in identifying and planning to minimise environmental risks.³⁶

Green opposition to Project MOSE

Environmental opposition to Project MOSE has taken various forms as political conditions have changed. Although the Greens have enjoyed little success in general elections, it would be a mistake to ignore how they have influenced public policy on issues such as the mobile barriers.

The ability of Green Party members and their associates in environmental NGOs to challenge the mobile barriers was transformed by the inclusion of the Green Party in government for the first time in 1996.

By 1998, the Italian Environment Ministry, dominated by the Green Party and influenced by environmental NGOs, had produced a 400-page report criticising Project MOSE through the Ministry's National Committee of Environmental Evaluation. The report asserted that other anti-flooding measures should be pursued before a revised version of the mobile barriers 'could be reconsidered once basic work to re-establish the general health of the lagoon and the city has been undertaken and its effects on their vulnerability to flooding taken into account'.³⁷

Based on this report, the Environment Minister and leading Green Party member, Edo Ronchi, issued a decree halting Project MOSE at the end of 1998 until the Regional Administrative Tribunal for the Veneto (TAR) ruled this decree invalid for technical reasons in 2000. Then the Green Party made abandoning Project MOSE a condition for its participation in the 2000 government led by Giuliano Amato.³⁸

The Green Party was not represented in the next government elected in 2001 and headed by Silvio Berlusconi. As prime minister, Berlusconi chairs the Committee for Policy, Coordination and Control (Comitatone) that is responsible for coordinating all measures to safeguard Venice and the lagoon. The Comitatore unanimously approved the final design stage of Project MOSE on 6 December 2001.

The first financial instalment of €450 million for Project MOSE's development from 2002–4 was approved on 29 November 2002. Berlusconi led the inauguration ceremony for Project MOSE on 14 May 2003. 'This is not a good day for Venice, or Italy,' was the response of Eduardo Zanchini, who monitors the mobile barriers for Italy's leading environmental group, Legambiente.³⁹ The Green Party exerts considerable influence within Venice's City Council that has a long history of challenging the central government's attempts to implement MOSE. Venice's City Council contributed towards stalling definitive approval for Project MOSE at the government's Comitatore meetings on 4 and 25 February 2003. When Project MOSE was given the final go-ahead on 3 April 2003, Venice's City Council put up eleven conditions, including plans to raise pavements and protect lower-lying parts of Venice from floods, and testing some alternatives to Project MOSE. Venice's Mayor, Paolo Costa, managed to prevent outright revolt from Greens in Venice's City Council by presenting the eleven conditions for 'the equilibrium of the lagoon's morphology'.⁴⁰

The government's Comitatore Committee was under no obligation to consider these conditions to give definitive approval to Project MOSE. Acceptance of the eleven conditions indicated that even Berlusconi's government has capitulated to environmental precaution. This government, with its exceptionally large parliamentary majority, was under no pressure to give in to Green Party members with their weak parliamentary representation. These conditions and this agreement were satisfactory 'from an environmental point of view,' said the Environment Minister, Altero Matteoli.⁴¹

Most NGOs are still challenging Project MOSE. Court actions are central to their opposition. In 1998, Italia Nostra attempted to stop the floodgates by taking a case to the European Commission that claimed the CVN's control of the project was an illegal monopoly. In 2002, much to the annoyance of environmentalists, the Commission closed the case, allowing CVN to continue Project MOSE providing parts of it were put out to bidding.

Earlier this year, WWF and Italia Nostra worked closely with Venice's City Council and the Veneto Regional Council to suspend work already started by CVN at Venice's Malamocco entrance to the lagoon. They successfully appealed to the TAR Tribunal in February 2003.⁴²

Undoubtedly, there will be many further battles with environmentalists before Project MOSE is completed.⁴³ In Italy's turbulent political system, the tide could easily turn against the mobile barriers. The leader of the government opposition coalition is former Green Party member Francesco Rutelli. A change of government could mean that funds for Project MOSE dry up.

Global warming and Venice

Despite the scientific uncertainty regarding climate change, the media have contributed to the linkage of global warming and Venice 'sinking'. This perception is supported by many experts who also argue that climate change means Project MOSE is useless. 'Floodgates "won't save Venice" '⁴⁴ and 'Venice flood barriers scheme "will soon be obsolete" '⁴⁵ were the titles of articles for BBC Online and the UK's *Independent* newspaper after Paolo Pirazzoli published an article for a journal of the American Geophysical Union. Pirazzoli, a marine geophysicist at the French National Centre for Scientific Research, believes that Project MOSE does not take global warming into account: 'The weakness in the project can be explained by the fact that the system was officially put forward in 1981 and has not been subsequently adapted to the predictions of greenhouse gas buildup-related sea-level rise which have been foreseen since 1982.'⁴⁶

To delay Project MOSE, interest groups have used studies by experts who assert that global warming will make the project deficient. For example, *Environment Magazine* has championed the work of the American archaeologist Albert Ammerman as 'the gates' most prominent critic'.⁴⁷ Ammerman and his colleague, Charles McCledden from Colgate University (New York), contend that their campaign against Project MOSE is based on their archaeological insights in an article in the journal *Antiquity*.⁴⁸

However, it was an article by Ammerman and McCledden in the journal *Science* that provoked a reaction beyond the scientific community.⁴⁹ Ammerman and McCledden asserted that the Environmental

Impact Study's scenarios for RSL were invalid because they were based on short-term tide-gauge data.⁵⁰ But the International College of Experts analysed the EIS scenarios and endorsed them.⁵¹

Ammerman and McClennen estimated Venice's RSL rise:

If we start with the average, long-term rise in RSL as a baseline (13 cm per century), add a safety margin (4 cm per century), and make a minimal allowance for global warming (13 cm over the next 100 years), a value of 30 cm is obtained for a new low projection of the rise in RSL. The 'worst-case' scenario (high estimate) would be on the order of 100 cm.⁵²

But the data presented here does not justify the authors' projections. They correctly highlighted the need for measurements over a long period of time to establish reliable trends. Their own archaeological work has led them to their estimates from AD 400 through to 1900 for RSL trends. This is used for the first part (13 cm) of their forecast for RSL rise during the 21st century.

This estimate is rather low considering the RSL rise was 23 cm during the twentieth century, as the authors acknowledge.⁵³ The additional 13-cm estimate 'for global warming' over the next 100 years is not based on their archaeological work, nor is the 4 cm 'for safety'. So only 13 cm out of 30 cm of their low estimate for RSL rise is justified by their archaeological findings, and they did not explain how they arrived at their 'high estimate' of 100 cm.

Ammerman and McClennen based their predictions for global warming on forecasts by the IPCC. Indeed, in the *Science* article they wrote: 'If the new Intergovernmental Panel on Climate Change (IPCC) report that is forthcoming sustains its previous position on global warming, then the handwriting could be on the wall regarding the project.'⁵⁴

In fact, the IPCC's Third Assessment Report in 2001 published after the *Science* article revised its estimated range of total sea-level rise until 2100 downwards from a range of 38 cm to 55 cm, to a range of 31 cm to 49 cm.

While opponents of Project MOSE have published papers arguing the project will soon be useless, the substantive studies on Project MOSE have been positive. The EIS gave Project MOSE overall approval. The International College of Experts, assembled for an objec-

tive assessment of the EIS and other studies, was positive about the project. Rafael Bras of the Massachusetts Institute of Technology (MIT), who disputes predictions that high sea-level rises will make the gates redundant, led this team of international experts: 'The bottom line is that the gates work ... To argue that the design of the barriers did not consider sea-level rise is just wrong ... The barriers, as designed, separate the lagoon from the sea in an effective, efficient and flexible way, considering present and foreseeable scenarios.'⁵⁵

Debates will continue about climate change and global warming because sea-level rises are very difficult to predict in assessing how to protect Venice from flooding.

How will rising sea levels affect Venice?

The debate about Project MOSE and rising sea levels focuses on the extent of predicted gate closures. A large number of gate closures could cause potential problems for shipping and pollution in the lagoon. Projections for gate closures inevitably depend on forecasts for the RSL, because higher rises will increase the number of occasions when the gates will block the sea from the lagoon.

According to Brotto and Gentilomo, a rise of 20 cm to 30 cm in RSL would generate a negative number of gate closures. This would have an impact on ships, which would be restricted from entering the lagoon.⁵⁶ The current sea level means the gates would be closed for 80 hours a year⁵⁷ disrupting 2.3% of sea traffic.⁵⁸ A 20-cm RSL rise would mean closures for 500 hours a year⁵⁹ disrupting 13.3% of traffic.⁶⁰ Each gate closure will last approximately 4.5 hours.

Ammerman and McClennen believe that their low projection for RSL rise (30 cm over the next 100 years) could produce 94 to 150 gates closures a year.⁶¹ In addition, the Environmental Impact Study considered scenarios for gate closures over the next 50 years. It concluded that under the worst-case scenario for sea-level rise of 20 cm by 2050, the number of gate closures would increase from twelve per year under current conditions to 70.⁶²

If the RSL does rise to produce a high number of gate closures, there are a number of possible positive responses. Forecasting gate closures and better planning and communication about when to pass into the lagoon could reduce disruptions to sea traffic. The diffuse measures that are vital to complement Project MOSE could also

minimise the need for gate closures. Raising vulnerable areas of Venice by 120 cm would keep the number of gate closures to twelve per year with a 20-cm RSL rise by 2050, according to the International College of Experts.⁶³

Opponents of Project MOSE also believe that gate closures will cause more pollution. Ammerman and McClellan have described the seasonal nature of Venice's high tides, and they predicted frequent closures during the winter months of October through January.⁶⁴ They suggested: 'As such a high concentration of gate closures will limit the circulation of water that is essential to biological life in the lagoon, this could have negative impacts on levels of water pollution and the ecology of the lagoon.'⁶⁵

It is true that gate closures are more likely during the winter. But pollution is a much greater problem in Venice during the summer than the winter, as examined by Cecconi (as head of the CVN engineering department).⁶⁶ So a concentration of gate closures during the winter may actually be more beneficial than if the gate closures were spread out over the year.

Closing Project MOSE's gates could also have a positive impact on the lagoon, reducing pollution by flushing the whole lagoon and decreasing the presence of pollutants. Reducing the ebb and flow could also minimise the silting of canals and the loss of sediment from the lagoon.⁶⁷ A report by experts connected with the CVN company explained how the mobile gates could be used to reduce pollution and benefit marine life:

Once storm surge gates have been installed, they can also be used to induce lagoon flushing. By preventing water leaving through the central tidal opening, a net circulation flux through this opening of 2000m³/s will result. This will flush the tidal flats south of Venice and immediate benefits can be expected in terms of the oxygen content during periods of fast *Ulva* biomass decay.⁶⁸

The International College of Experts found that with the current sea level the gates would need to be closed on twelve occasions a year and that this would have 'negligible' impact on the lagoon's environment. With a possible sea-level rise of 10 cm between 2030 and 2100, the gates would block the sea from the lagoon 30 times a year: 'By this

time, some effect on the natural system of the lagoon may become measurable, although it is expected to be small.⁶⁹

The experts did foresee a 'measurable' effect on the environment if the sea level rises by 20 cm leading to 70 gate closures a year, which could happen by 2050 with a pessimistic scenario. However, their report points out that by the middle of the 21st century, we will have the benefit of increased knowledge and experience to inform decisions about how to protect Venice.⁷⁰

For now, Project MOSE plus the diffuse *insulae* measures appears to be the best way to protect Venice. Even if we accept the pessimistic predictions for RSL rise and gate closures, the potential problems regarding shipping and pollution seem manageable.

If climate change brings very significant sea-level rises, Project MOSE would not necessarily be redundant. Additional measures could be carried out with the mobile barriers continuing to provide some protection. For example, local defences could be raised by a further 20–30 cm beyond current allowances, shipping locks could be constructed, or the lagoon could be separated into several basins⁷¹ or two parts (sub basins).⁷²

This adaptive approach to Project MOSE and the complementary measures is the best way to protect Venice against immediate and future RSL rise. The gates are mobile, so they can flexibly respond to separate the lagoon from the sea as conditions change.

Environmental risks and the precautionary principle

Italian environmental groups have based their opposition to Project MOSE on a profound aversion to risk. It is claimed that Venice's future is being placed in jeopardy by reckless gambling. Gaetano Benedetto of WWF Italy greeted the approval of Project MOSE's final design stage by stating: 'Today the city's destiny rests on a pretentious, costly and environmentally harmful technological gamble.'⁷³

In fact, standard risk assessments of Project MOSE have been conducted by engineers to test its safety. A committee of international experts from leading engineering companies approved the design of the project in 1993. But adopting the precautionary principle implies that 'technology ought to be severely restricted if not banned, unless it can be proven to be absolutely safe.'⁷⁴

Tony Zamparutti, a member of the environmentalists' committee

'Save Venice with its Lagoon', recently wrote in *The Ecologist* magazine that a 1984 special law on Venice meant the precautionary principle could be applied to block Project MOSE: 'In language that presages the precautionary principle, the law calls for all interventions to be "experimental, gradual and reversible".'⁷⁵

The application of the precautionary principle to Project MOSE brought environmental precaution on to the political stage and led to further delays. This started when environmentalists in Venice's City Council demanded that the mobile gates be scrutinised by an Environmental Impact Study (EIS). The government's Comitato Committee agreed, even though projects of this kind were not subject to Italian law on environmental impact assessment. The EIS stalled Project MOSE between 1995 and 1997. But this was only the first instance of an Italian government adopting environmental precaution for Project MOSE. Subsequently, the International College of Experts was hired to assess the EIS, delaying Project MOSE until 1998.

When Italy's government called in experts to assess an assessment, years after engineers concluded their risk assessments, political concerns with environmental precaution became detached from the safety of Project MOSE itself. The institutionalisation of the precautionary principle enabled governments to appear highly concerned about the safety of their citizens on an emotive issue, although they were held in rather low esteem in many traditional aspects of politics. The precautionary principle was employed as a political tool by Italian politicians, who were suffering a legitimacy crisis.⁷⁶

The precautionary principle has been applied to many aspects of the Venetian lagoon. For example, the International Navigation Association Report on Environmental Management for Ports suggested a role for the precautionary principle in managing Venice's port: 'When the risks of serious or irreversible environmental damage are high and cost penalties are low, the Precautionary Principle is easily justified. In other circumstances when the risks are lower it may be better to undertake further scientific research rather than invoking the Principle.'⁷⁷

Even perceptions of man's relationship to the lagoon have been changed by the application of the precautionary principle to Project MOSE. Giovanni Mazzacurati, as General Manager for the CVN company in charge of Project MOSE, suggested:

In the context of the Venice Lagoon, the concepts of ‘fate’ or ‘emergency’ should no longer arise, or at least they should no longer be formulated in the customary terms ... We can in fact predict the effects of hidden problems before the results become obvious and lay our hands on solutions which have been adequately studied, tested and made effective.⁷⁸

But is this risk-aversion – manifested through Project MOSE – a sensible strategy when the risks of sinking and flooding to Venice are imminent? There are, of course, risks to implementing Project MOSE, but these risks are minimal in relation to the benefits of its construction. Classical notions of risk were based on mathematical probabilities.⁷⁹

Unfortunately, such balanced risk assessments have been replaced by the precautionary principle, which encourages extreme caution but may indeed exacerbate safety concerns by attempting to deny that risks exist. The adoption of the precautionary principle by all the key players regarding Project MOSE – environmentalists, Venice City Council, successive governments, the CVN company, the port authorities – can only further delay its construction.

Is it ‘unnatural’ to be ambitious for Venice?

Venice is deserving of our efforts to protect it – it is sinking, and we should do something about it. But those with a preservationist mentality – such as the opponents of Project MOSE – believe that we can have a world without trade-offs. According to this mindset, intervening in nature for human benefit is inconceivable as it changes the state of the lagoon. Stefano Lorenzi of WWF Italy criticised Project MOSE ‘for its inefficient environmental impact in maintaining the equilibrium of the lagoon’s ecosystem’.⁸⁰

They baulk at doing what is necessary for Venice’s protection to sustain a mythical harmony between man and nature. But how can human societies develop if we do not separate nature from society? Italia Nostra’s Venice website complains: ‘Unfortunately, too many politicians, planners, architects and engineers have sought to “modernise” Venice and its Lagoon over the past century ... Italia Nostra has promoted a different vision: the projects that define the future of Venice should be designed with the water in mind.’⁸¹

Indeed, people throughout the entire history of Venice have sought modernisation and could hardly ignore the water. But to environmental groups, parting the seas with mobile barriers is an arrogant attempt to dominate nature that will undoubtedly change marine and plant life in the lagoon. However, transforming the lagoon is exactly what we need to do to protect Venice.

The construction and maintenance of Venice has been one of the greatest engineering achievements of mankind.⁸² The unusually close relationship between a city and water-dominated conditions has required a high level of human intervention.

Conclusion

Something must be done to protect Venice from flooding. Project MOSE plus diffuse/*insulae* measures will not prevent all flooding indefinitely. But they provide the best solution for the foreseeable future. Project MOSE has been debated for over 30 years and the leading authorities had approved its design by 1994. Standard risk assessments by engineers were favourable and international experts from leading engineering companies approved it in 1993. Since 1995, environmentalists in Italian NGOs and the Green Party have led the campaign to stall Project MOSE. Through their role in governments, their initiation of the Environmental Impact Study, and court actions, they have promoted a precautionary approach towards Project MOSE.

The precautionary principle has become the *modus operandi* for Project MOSE under successive governments. Agreeing to the EIS and calling in the International College of Experts delayed the project from 1995 to 1998, but it then took until 2003 to definitely approve it. Even Berlusconi's current government made concessions to environmental precaution as it inaugurated the floodgates. All the key players in relation to Project MOSE have adopted the precautionary principle. This suggests that a culture of environmental precaution has superseded rational risk assessments and become an automatic response for the management of such projects. Environmental precaution has already become influential in plans to build the world's longest suspension bridge to Sicily⁸³ and is likely to hinder the completion of Project MOSE in 2011.

Venice has played a key role in the climate change debate, and fears over Venice 'sinking' because of rising sea levels have been blown out

of proportion by the news media. This misrepresentation has been aided by widely questioned projections for total sea-level rises by the IPCC and some academics that have predicted very high increases in the relative sea level for Venice.

Given that the major problem with Venice in the twentieth century was subsidence – i.e. sinking – we should prioritise our actions to limit flooding due to sinking and rising sea levels. While there will be costs to actions, attentive management will minimise the impact of frequent gate closures on shipping and pollution in the lagoon.

How exactly the earth's climate will change is uncertain, and the consequences for humanity are also uncertain – but the solution is not to focus on how to restrict humanity's interaction with nature. If sea levels do rise, then Venice will have to adapt. Such actions are more likely to complement the protection provided by Project MOSE than to make it redundant.

Rather than fearing climate change and resorting to climate alarmism, we should employ a rational assessment of how climate changes may affect us, and then we can adapt with appropriate responses. Project MOSE is a positive, adaptation-oriented response, which will protect the historical city of Venice from being overly affected by flooding.

The sea was formerly considered a great advantage for Venetians in terms of salt, marine life, defence and as a means of transport: it enabled Venice to become the gateway to the Orient despite a constant battle to protect the city from the lagoon, rivers and the sea.⁸⁴ Now these waters are perceived as a threat and this view is perpetuated by the idea that humans cannot and should not interfere with nature. In reality, the lagoon continues to be a great advantage to the city for its tourist trade and over US\$1 billion a year generated by the port. Project MOSE and the complementary measures should aid the reconstruction of a positive attitude towards the lagoon, the sea and human-inspired change.

Notes

- 1 James (2002).
- 2 WWF Italy 2003.
- 3 Norwich (1982).
- 4 Gentilomo and Warnock (1997), p. 2.
- 5 Day *et al.* (1999), p. 609.
- 6 Cecconi, Canestrelli, Corte and Di Donato (1997a), p. 1.
- 7 Gentilomo and Cecconi (1995), p. 435.
- 8 Cecconi (1997b), p. 5.
- 9 *Ibid.*, p. 16.
- 10 Ghetti (1988), p. 28.
- 11 Cecconi (1997c), p. 1.
- 12 Gentilomo and Warnock (1997), p. 8.
- 13 Day *et al.* (1996), p. 9.
- 14 Guthrie (2001).
- 15 Ghetti (1988), p. 26.
- 16 *Ibid.*, p. 27.
- 17 Zucchetto (2000).
- 18 Cecconi (1997c), p. 3.
- 19 Cecconi (1997c), p. 2.
- 20 An historical tidal gauge on the island opposite St Mark's Square.
- 21 Fay and Knightley (1976).
- 22 'The rise in sea level caused by variations in atmospheric pressure and the wind occurs unexpectedly. This rise, calculated as the difference between the measured level and the astronomical tide, is known as a storm surge', in Cecconi (1997b), pp. 5-6.
- 23 Cecconi (1997c), pp. 4-5.
- 24 Agenzia Giornalistica Italia (2003).
- 25 International College of Experts (1998), p. 5.
- 26 Not all NGOs are against Project MOSE. Preservationist organisations based outside Italy, such as 'Venice in Peril' (UK) and 'Save Venice' (USA), have been generally positive about the mobile barriers. It is Italian environmental NGOs such as Italia Nostra, WWF Italy and Legambiente that have consistently opposed Project MOSE.
- 27 Brotto and Gentilomo (1998), p. 23.
- 28 International College of Experts (1998), p. 5.
- 29 *Ibid.* p. 46.
- 30 Gentilomo (1997), p. 32.
- 31 Zitelli and Rossetto (1996), p. 1.
- 32 Scarton, Perco and Borella (1996), p. 4.
- 33 Gentilomo (1997), pp. 35-36.
- 34 Gentilomo (1997), p. 34.
- 35 International College of Experts (1998), p. 31.
- 36 Gentilomo, M. *et al.* (1999), p. 14.
- 37 Quoted in Keahey, J. (2002), p. 240.

- 38 Communiqué of the Greens' Political Office, 28 April 2000 in Biorcio
(2002), p. 55.
- 39 Anon (2003).
- 40 Baccaro (2003).
- 41 Fornasier (2003).
- 42 Vitucci (2003).
- 43 Standish (2003b).
- 44 Podger (2002).
- 45 Connor (2002).
- 46 Pirazzoli (1992).
- 47 Woodard (2003).
- 48 Ammerman *et al.* (1999).
- 49 Ammerman and McClennen (2000).
- 50 *Ibid.*
- 51 International College of Experts (1998), p. 17.
- 52 *Ibid.*
- 53 *Ibid.*
- 54 *Ibid.*
- 55 Connor (2002).
- 56 Brotto and Gentilomo (1998), p. 19.
- 57 Cecconi (1997c), p. 6.
- 58 Brotto and Gentilomo (1998), p. 24.
- 59 Cecconi (1997c), p. 6.
- 60 Brotto and Gentilomo (1998), p. 24.
- 61 Ammerman and McClennen (2000).
- 62 Italian Ministry of Public Works *et al.* (1997), p. 96.
- 63 International College of Experts (1998), p. 25.
- 64 Ammerman and McClennen (2000).
- 65 *Ibid.*
- 66 Cecconi (1997c), p. 5.
- 67 *Ibid.*, p. 6.
- 68 Runca *et al.* (1996), p. 16.
- 69 International College of Experts (1998), p. 6.
- 70 *Ibid.*, p. 6.
- 71 Cecconi (1997c), p. 4.
- 72 Gentilomo (1997), p. 5.
- 73 Standish (2001b).
- 74 Goklany (2001), p. 2.
- 75 Zamparutti (2003).
- 76 I have explored elsewhere how Italian social policy for environmental
management and beyond has become increasingly governed by the
precautionary principle. See Standish (2001a).
- 77 Gentilomo *et al.* (1999), p. 11.
- 78 Mazzacurati (1996), pp. 1–2.
- 79 Berstein (1998), pp. 48–50.
- 80 Standish (2002b).
- 81 Italia Nostra (no date).

- 82 Standish (2003a).
83 Standish (2002a).
84 Morris (1993), p. 11.

Bibliography

- Agenzia Giornalistica Italia, 'MOSE: Galan, there is hope for Venice', <http://www.agi.it>, 5 April 2003.
- Ammerman, A. J., McClennen, C. E., De Min, M. and Housley, R. (1999), 'Sea-level change and the archaeology of early Venice', *Antiquity* 73, pp. 303–12.
- Ammerman, A. J. and McClennen, C. E., 'Saving Venice', *Science*, vol. 289, issue 5483, p. 1301, 25 September 2000.
- Anon, 'Italy Starts Work on Sea Gates Intended to Avert Venice Floods', *New York Times*, 15 May 2003.
- Baccaro, A., 'Dighe mobili a Venezia. Via al piano dopo 37 anni', *Corriere della Sera*, 4 April 2003.
- Berstein, P., *Against the Gods. The Remarkable Story of Risk* (New York, John Wiley, 1998), pp. 48–50.
- Biorcio, R. (2002), 'Green Parties in National Governments: Italy', *Environmental Politics*, Spring, vol. 11, no. 1.
- Brotto, M. T. and Gentilomo, M. (1998), 'The Venice Lagoon Project. The Barriers at the Lagoon Inlets for Controlling High Tides', in *Bulletin AIPCN-PIANC*, no. 98.
- Cecconi, G., Canestrelli, P., Corte, C. and Di Donato, M. (1997a), 'Climate Record of Storm Surges in Venice', in *Impact of Climate Change on Flooding and Sustainable River Management*, RIBAMOD Workshop, Wallingford, 26–27 February 1998.
- Cecconi, G. (1997b), 'Real time storm and watershed inflow forecasting in the Venice lagoon', in *Integrated System for Real Time Flood Forecasting and Warning*, RIBAMOD Workshop, Monselice, 25 September 1997.
- Cecconi, G. (1997c), 'The Venice Lagoon Mobile Barriers. Sea Level Rise and Impact of Barrier Closures', in *Italian Days of Coastal Engineering*, 16 May 1997.
- Connor, S., 'Venice flood barriers scheme "will soon be obsolete"', *Independent*, 13 May 2002.
- Day, J. W., Are, D., Rismondo, A., Scarton, F. and Cecconi, G. (1996), 'Relative Sea Level Rise and Venice Lagoon Wetlands', in *Active Protection and Water Flow Restoration of the Venice Lagoon*, Monographic Supplement to Quaderni Trimestrali.
- Day, JR. J. W. *et al.* (1999), 'Soil Accretionary Dynamics, Sea Level Rise and the Survival of Wetlands in the Venice Lagoon: a field and modelling Approach', in *Estuarine, Coastal and Shelf Science*, 49.
- Fay, S. and Knightley, P., *The Death of Venice* (New York, Praeger Publishers, 1976).

- Fornasier, C. 'MOSE, via libera dopo 37 anni di odissea', *Corriere del Veneto*, 4 April 2003.
- Gentilomo, M. and Cecconi, G. (1995), 'The Venice Barriers', in *Spatial Structures: Heritage, Present and Future*, International Symposium, Milan/Padua, vol. 1.
- Gentilomo, M. and Warnock, J. (1997), *Sustainable Safeguards for the Protection of the Lagoon and the City of Venice*, Atti del IX World Water Congress, Montreal, Canada.
- Gentilomo, M. (1997), *The Venice Lagoon Project. Mobile barriers at the lagoon inlets for controlling high tides*, in Atti del Symposium del 24 maggio 1997, Florence International Conference on Large Dams (ICOLD).
- Gentilomo, M. et al. (1999), *Environmental Management Framework for Ports and Related Industries*, International Navigation Association, Report of Working Group 4.
- Ghetti, A. (1988), 'Subsidence and Sea-Level Fluctuations in the Territory of Venice', in *Landscape and Urban Planning*, no. 16.
- Goklany, I., *The Precautionary Principle. A Critical Appraisal of Environmental Risk Assessment* (Washington DC, Cato Institute, 2001).
- Guthrie, R. (2001), 'History of Venice on the Water', Save Venice Inc., <http://www.savevenice.org/>, 22 January 2001.
- International College of Experts (1998), 'Report on the mobile gates project for the tidal flow regulation at the Venice lagoon inlets', Venice, in *Numero speciale dei Quaderni Trimestrali*.
- The Italian Ministry of Public Works, The Venice Water Authority and the New Venice Consortium (1997), *Environmental Impact Study (EIS) of the Preliminary Plan for Mobile Barriers at Lagoon Inlets for the Defence Against High Waters* (Venice).
- Italia Nostra, Venice Chapter, 'A Commitment for Action', <http://www.provincia.venezia.it/italianostra/1quale/1which.htm>
- James, B., 'A global threat laps at the gates of Venice', the *International Herald Tribune*, 22 March 2002.
- Keahey, J., *Venice Against the Sea* (New York, St Martins Press; 2002).
- Lomborg, B., *The Skeptical Environmentalist. Measuring the Real State of the World* (Cambridge, UK, Cambridge University Press, 2001).
- Mazzacurati, G. (1996), 'Water Flow Restoration and the Active Protection of the Venice Lagoon', in *Active Protection and Water Flow Restoration of the Venice Lagoon*, Monographic Supplement to Quaderni Trimestrali.
- Morris, J., *Venice*, (London, Faber and Faber, 1993).
- Norwich, J. J., *A History of Venice* (London, Penguin, 1982).
- Podger, C., 'Floodgates "won't save Venice"', BBC News Europe Online, 13 May 2002.
- Pirazzoli, P. (1992), 'Did the Italian Government Approve an Obsolete Project to Save Venice?' *EOS*, Transactions, American Geophysical Union, vol. 83, no. 20, 14. 5. 2002, pp. 217-23.
- Runca, E., Bernstein, A., Postma, L. and Di Silvio, G. (1996), 'The framework of analysis to evaluate environmental measures in the Venice lagoon', in *Active*

- Protection and Water Flow Restoration of the Venice Lagoon*, Monographic Supplement to Quaderni Trimestrali.
- Scarton, F., Perco, F. and Borella, S. (1996), 'The importance of protecting lagoon habitats for bird life', in *Active Protection and Water Flow Restoration of the Venice Lagoon*, Monographic Supplement to Quaderni Trimestrali.
- Standish, D. (2001a), 'Beware of the Precautionary Principle', Italy Daily section of the *International Herald Tribune*, 24 April 2001.
- Standish, D. (2001b), 'Flap Project Will Save Venice', Italy Daily section of the *International Herald Tribune*, 10 December 2001.
- Standish, D. (2002a), 'Big projects, small minds', *Spiked-online*, <http://www.spiked-online.com>, 17 July 2002.
- Standish, D. (2002b), 'Will sinking Venice raise our ambitions?' Italy Daily section of the *International Herald Tribune*, 3 December 2002.
- Standish, D. (2003a), 'A view from the bridge', in *The Architects' Journal*, 3 April 2003, pp. 38–39.
- Standish, D. (2003b), 'Barriers to Barriers', Tech Central Station, <http://www.techcentralstation.be/2051/>, 29 April 2003.
- Vitucci, A., 'Berlusconi arriverà il 29 aprile', *La Tribuna di Treviso*, 4 April 2003.
- World Wildlife Fund (WWF Italy), 'MOSE, WWF e Italia Nostra ricorrono al TAR', http://www.wwf.it/news/322003_1634.asp, 3 February 2003.
- Woodard, C., 'The Sinking City', *E/The Environment Magazine*, vol. XIV, no. 2, March–April 2003, http://www.emagazine.com/march-april_2003/0303curr_venice_intro.html
- Zamparutti, T., 'Venice in Peril', *The Ecologist*, 22 March 2003.
- Zitelli, A. and Rossetto, P. (1996), 'Techniques in the environmental restoration programme of the Venice lagoon: The 'Palude della Rosa' pilot project', in *Active Protection and Water Flow Restoration of the Venice Lagoon*, Monographic Supplement to Quaderni Trimestrali.
- Zucchetta, G. (2000), *Storia dell'acqua alta a Venezia*, Marsilio, Venice.